

of layers of amorphous metal strips, wherein each of said strips has a top and a bottom surface and is oriented such that (i) a line normal to either of said surfaces at substantially any point thereon is substantially perpendicular to the axis of rotation of said rotor, and (ii) said flux traverses said segment without crossing an air gap, and said stator having a core loss less than "L" when operated at an excitation frequency "f" to a peak induction level  $B_{max}$  wherein L is given by the formula  $L = 0.0074 f (B_{max})^{1.3} + 0.000282 f^{1.5} (B_{max})^{2.4}$ , said core loss, said excitation frequency and said peak induction level being measured in watts per kilogram, hertz, and teslas, respectively; and

- b) means for supporting said stator and said rotor in predetermined positions relative to each other.

#### **REMARKS**

The Examiner's withdrawal of the rejection of claim 36 under 35 U.S.C. 103(a) as being unpatentable over U.S. Patent 4,255,684 to Mischler et al. and U. S. Patent 5,439,534 to Takeuchi et al. is noted with appreciation.

Claims 1, 22, 26, 35, and 36 have been amended to recite an amorphous metal stator comprising a plurality of layers of amorphous metal strips, each of the strips having a top and a bottom surface. The strips are oriented in the stator such that a line normal to either of the top and bottom surfaces of the strips is substantially perpendicular to the axis of rotation of the electric motor rotor with which the stator is associated. The amendment is clearly supported by the specification, particularly at page 6, lines 20 - 25; and Figs. 3 - 5. Consequently, no new matter has been added by way of this amendment.

Claims 1, 2, 3, 8, 19-22, and 35 have been rejected under 35 U.S.C. § 103(a) as being unpatentable over German Patent Document 28 05 438 (the "438 patent") and U.S. Patent No. 4,255,684 to Mischler et al.

The '438 patent discloses a motor comprising an iron core made of layers. The iron core consists of separate parts, which form joints having variable reluctance elements inserted therein. Strips of non-magnetic materials such as plastic foil hold the joints apart. Each of the joints opens out to form a large rectangular window near the inner face which may be used to hold coil windings. In operation, the flux must cross an air gap between the ends of a back and a tooth section. This disclosure does not teach that the metal used is an amorphous metal. Thus, the '438 patent teaches a conventional, crystalline metal stator wherein the flux must cross at least one (and most likely more than one) air gap.

Mischler et al discloses a stator structure for use in a motor which is fabricated using strip material and moldable magnetic composite, either amorphous metal tape and amorphous flake or similar conventional materials.

The Examiner has indicated that each of the back iron sections in the '438 disclosure has a top and a bottom surface which has a line normal to the surface being perpendicular to the axis of rotation of the rotor. Figure A1 of applicants' appeal brief, submitted November 6, 2002 in the present matter, reproduces the Figure of the '438 German Patent, which depicts a generally cylindrical stator 1 for use in a motor having a rotor appointed to rotate generally about the cylindrical axis of the stator. A copy of the appeal brief figures is enclosed herewith for the Examiner's convenience. Applicants acknowledge that Figure A1 depicts back iron sections 2 in which a line normal to the surface of any of the layers of the back iron sections is perpendicular to the cylindrical axis of the stator, and consequently, to the axis of the rotor with which stator 1 is

appointed for use. Representative examples of such normal lines are indicated as directions "B-B" superimposed on the '438 Figure in applicants' Figure A2 and in plan view in applicants' Figure A3. However, applicants respectfully submit that pole shoes 3 in Figure A1 are composed of a plurality of layers stacked parallel to the stator's cylindrical axis. Each of those layers has a top and a bottom surface, and a normal to either surface at any point of any of the layers is therefore directed parallel the stator's cylindrical axis, and, hence, parallel the axis of the rotor with which stator 1 is appointed for use. Representative examples of such normal lines are indicated as directions "P-P" superimposed on the '438 Figure in applicants' Figure A2.

By way of contrast, applicants' claims 1, 22, and 35, as well as claims 2, 3, 8, 19 - 21 dependent thereon, as amended, recite a stator comprising a plurality of segments, each segment being comprised of a plurality of amorphous metal strips, each of which has a top and a bottom surface. In addition, each claim calls for a line normal to either surface of the strips at substantially any point thereon to be substantially perpendicular to the axis of rotation of the rotor. More specifically, the term "surface" is set forth in the claims with reference to the strips used in the construction of each segment of the stator. Applicants respectfully submit that this requirement clearly calls for the perpendicularity to be satisfied for the strips present in all segments comprised in the claimed stator, not just for some segments.

The Examiner has stated that "[T]he top and bottom surfaces of the laminations are the radially inner and outer surfaces of the poles 3, not the planar side surfaces as shown in applicants' [Figure A2]" and "The radially inner and outer surfaces of each individual lamination in '438 and the surface made from the combined laminations, are both 'surfaces' as set forth in the claims." These statements are, respectfully, traversed.

The term "surface", as used in proviso (i) at the end of line 4 of amended claim 1, clearly derives its antecedent basis from the first occurrence of the word "surface" in the phrase "a top and a bottom surface" bridging lines 3 and 4. The top and bottom surfaces, in turn, refer to the surfaces of the layers of amorphous metal strip, also in line 3. A similar proviso (i) is also present in claims 22, 26 and 35. The term "surface" is used in the same sense in these claims as it is in claim 1. In particular, all the claims refer to a "line normal to either surface," i.e., a line normal to either the top surface or the bottom surface of any of the layers of amorphous metal. That line is to be taken from a point "thereon," i.e., a point on either the top surface or the bottom surface of one of the layers of amorphous metal.

Citing *In re Gears*, the Examiner has further indicated that limitations may not be read from the specification into the claims. Applicants respectfully submit that the aforementioned argument relies on the explicit wording of amended claims 1, 22, and 35, and not on any limitation inferred from the specification that must be read into the claims. That is to say, the term "surfaces", as used in proviso (i) of each of claims 1, 22, and 35, refers to the top and bottom surfaces of the individual constituent layers or laminations. As set forth in the specification (e.g. at page 6, lines 21-22), and as recognized in common parlance in the electrical steel art, a thin strip material, i.e. one having a length and a width substantially greater than its thickness, has a top surface and a bottom surface. One of ordinary skill in the electrical motor construction art would thus clearly recognize and identify the top and bottom surface of either the electrical steel used in constructing the stator of the '438 patent or the stator recited by applicants' claims. Such a person would further recognize that a stack of identically shaped, planar strips of either material would have faces, but would clearly recognize that some of these faces are defined by the edges of the individual laminations, and would understand that such faces are not "surfaces" in the sense used in the claims. Therefore, it is

respectfully submitted that the person of ordinary skill would not read applicants' claims in the manner suggested by the Examiner.

To the contrary, such a person would recognize the stator depicted in the Figure of the '438 German Patent (reproduced as Figure A1) as comprising pole shoes (3) that include layers of steel having top and bottom surfaces oriented such that any line normal to either surface of the layers therein is parallel to, and not perpendicular to, the stator's cylindrical axis, which is also the axis of rotation of the rotor to be associated with the stator. Accordingly, the '438 German Patent is submitted to teach away from the stator recited by applicants' claims 1, 2, 3, 8, 19-22, and 35, since each requires that every segment therein be comprised of layers oriented with their normal direction perpendicular to the rotor axis. The Examiner has not pointed to any teaching in the '438 patent that would disclose or suggest any stator structure in which every segment, including the pole shoes, is comprised of layers of material oriented perpendicular to the rotor axis, instead of parallel as depicted in the Figure.

Applicants' claimed stator has exceptional magnetic properties, notably including low core loss, that render a motor constructed therewith highly efficient and capable of high-speed operation not possible with motors incorporating previously known magnetic components. As a result, a motor constructed with the presently claimed stator achieves higher power than previous motors of the same size and weight, while retaining higher efficiency. Moreover, the structure of the stator lends itself to highly efficient and cost-effective manufacture; and is especially suited to be incorporated into a highly efficient electric motor.

The Examiner has acknowledged that the '438 German Patent does not disclose a stator comprised of amorphous metal, and so has proposed to combine the Mischler et al. reference. The Examiner has indicated that Mischler et al. teaches a stator for a motor with a plurality of segments

formed from amorphous metal. Applicants respectfully traverse this indication. For example, Figure 1 of the Mischler reference depicts a stator having yoke structures 11 and 12 constructed of layers of continuous flat amorphous strip 13 and amorphous composite pole pieces 18 and 19. These pole pieces are not constructed of amorphous metal strips, and are instead said to be "amorphous metal flake or filament composite in a binder" (col. 1, lines 63-64). The path of magnetic flux is labeled "FLUX" in Figure 1 and clearly is seen not to traverse any air gap.

By way of contrast, the stator of present claim 1 is comprised of segments, each of which comprises a plurality of layers of amorphous metal strips. Moreover, flux traversing the segment crosses one air gap. Neither of these conditions is satisfied by any stator disclosed or suggested by Mischler et al. Accordingly, the structure of applicants' claimed stator is not suggested by Mischler or the '438 German Patent, either individually or collectively. In this respect, Mischler et al. does not suggest a modification of any structure taught by the '438 reference which would produce the stator required by each of applicants' claims 1, 2, 3, 8, 19-22, and 35.

Applicants maintain that the '438 patent fails to disclose or suggest any embodiment of a stator satisfying the geometrical limitations required by applicants' claims 1, 22, and 35.

In particular, the '438 patent teaches away from applicants' configuration, stating at page 14, lines 17 - 19: "Dabei sind die Einzelblechlagen 2a und 3a an den Stoßstellen rechtwinklig zueinander vorgesehen, d. h. sie kreuzen sich gitterartig." [*The individual sheet metal laminae 2a and 3a are disposed at right angles to each other at the abutment locations, that is to say, they cross each other in a lattice-like configuration.*]

Applicants are unaware of any disclosure by the '438 patent of other embodiments in which the laminations are not in perpendicular abutment as set forth both in the aforecited passage and in the Figure, and the Examiner has not pointed to any. Inasmuch as no structure satisfying the

requirements of amended claims 1, 2, 3, 8, 19-22, and 35 is disclosed or suggested by the combination of the '438 and Mischler et al. patents, applicant's respectfully submit that the claims are not properly subject to a rejection under 35 USC 103(a).

The Mischler et al. limitation that the flux does not jump an air gap places severe restrictions on the performance of their motor. If a continuous segment of the Mischler et al. motor is magnetized (for example, the segment 38 in Mischler et al.'s Fig. 7), then only the right half of the 12 o'clock tooth and the top half of the 3 o'clock tooth are magnetized. The other halves of the 12 o'clock and 3 o'clock teeth represent parts of different, unmagnetized, segments. Effectively, only half of the volume of each tooth is magnetized. Therefore, if segment 38 is magnetized to 1.5 T, the 12 o'clock tooth will perform as if the entire tooth were magnetized to only 0.75T. This would provide half the torque of a tooth fully magnetized to 1.5T.

Clearly, the Mischler et al. limitation that the flux does not jump an air gap places restrictions on the combinations of frequency, speed and torque at which their motor operates. These restrictions, which have heretofore made amorphous metal stators unsuitable for conventional motor applications, have been eliminated by the stator called for by present claims 1, 2, 3, 8, 19-22, and 35. In contrast to the teaching the '438 patent, as modified by Mischler et al., the stator called for by applicants' claims 1, 2, 3, 8, 19-22, and has backiron and teeth constructed such that radial flux passing through the stator crosses just one air gap when traversing each segment of the stator. Overall versatility of the motor is improved; operational ranges and levels of speed, frequency and torque are increased. When compared with any stator constructed from the combined teachings of the '438 patent and Mischler et al., the stator recited by present claims 1, 2, 3, 8, 19-22, and 35 is smaller, lighter, much less expensive to construct and far more versatile and efficient in operation.

Applicants respectfully submit that it was not obvious to manufacture an amorphous metal rotor having the structure of the '438 patent. Had it been obvious to do so, Mischler et al. and other prior art workers would have attempted to combine the teachings of the cited references and realized the significant advantages afforded by the stator delineated by applicants' claims. Clearly, up to the time of applicants' invention, no stator having the structure called for by claims 1, 2, 3, 8, 19-22, and 35 has been proposed by any prior art worker, including those represented on the '438 disclosure and Mischler et al. The prior art stators and their attendant disadvantages are discussed at pages 1 and 2 of the specification. It is submitted that the proposed combination of the '438 disclosure and Mischler et al. can be made only in light of applicants' own disclosure. Even then, any stator constructed from the combined teachings of the '438 disclosure modified in light of Mischler et al. would require substantial reconstruction and redesign which is not fairly taught by the references.

Assuming, arguendo that the '438 patent could be combined with Mischler et al., the resultant stator would still not possess a plurality of segments, each segment comprising a plurality of layers of amorphous metal strips, each of which has a top and a bottom surface and is oriented such that (i) a line normal to either of said surfaces at substantially any point thereon is substantially perpendicular to the axis of rotation of said rotor, and (ii) when traversing said segment, said flux crosses one air gap.

Rather, any stator constructed from the teachings of the cited references would be governed by Mischler's limitation that the flux does not jump an air gap. Restrictions placed on the combinations of frequency, speed and torque of such a stator by this limitation would render it unsuitable for many conventional motor applications. These restrictions have been eliminated by the amorphous metal stator called for by applicants' claims 1, 2, 3, 8, 19-22, and 35, which is

smaller, lighter, less expensive to construct and more versatile and efficient in operation than any stator produced from the combined teachings of the cited references.

The Examiner has further indicated that heat treatment, application of a magnetic field, and annealing are methods of making limitations not germane to the patentability of the apparatus. Applicants respectfully submit that heat treatment or annealing, whether or not a magnetic field is applied, structurally alters the stator recited in claims 19-21 and is thus properly germane to the determination of patentability of those claims. As set forth in the specification, e.g. at page 15, lines 7-16, heat treatment enhances the magnetic properties of the amorphous metal strip used in constructing the stator recited by claims 19-21. Moreover, the specification teaches that different forms of heat treatment result in different microstructures within the metal strip. The heat treatment recited at page 15, lines 10-11 modifies a substantially glassy or amorphous microstructure, whereas the heat treatment presented at page 15, lines 17-19 results in the formation of a nanocrystalline microstructure characterized by the presence of a high density of grains having average size less than about 100 nm. The specification teaches that each of these methods constitutes means for improving the magnetic properties of the amorphous metal strip, notably the core loss. A motor comprising a stator having low core loss operates with high efficiency and speed, low production of waste heat, and minimized need for auxiliary cooling means. The significance of low core loss is set forth in the specification, especially at page 16, line 30, through page 17, line 7, and is further discussed hereinbelow in conjunction with the rejection of claims 15-18 and 26-33 over the '438 patent and Mischler et al.

Moreover, claims 19 to 21 depend from claim 1, which is submitted to be patentably unobvious over any combination of Mischler et al. and the '438 German patent, for the reasons set

forth hereinabove. It is therefore submitted that dependent claims 19 to 21 are also patentable for at least the same reasons.

In view of the above remarks, applicants respectfully submit that the structural features of the stator are correctly characterized by claims 19-21 and provide proper basis defining patentably over the cited references. Further, it is submitted that the advantageous features afforded by the stator of present claims 1, 2, 3, 8, 19-22, and 35, including significant reductions in size and weight, lower construction costs and increased versatility and efficiency of operation, provide ample basis upon which to predicate their patentability over the art applied.

Accordingly, reconsideration of the rejection of claims 1, 2, 3, 8, 19-22, and 35 under 35 U.S.C. §103(a) as being unpatentable over the '438 patent and Mischler et al. is respectfully requested.

Claims 4, 5, and 23 have been rejected under 35 U.S.C. §103(a) as being unpatentable over the '438 disclosure and Mischler et al. in further view of U.S. Patent No. 2,556,013 to Thomas, which discloses dynamoelectric motors having stator members provided with salient field poles. The stators have an outer cylindrical protective and retaining member, which is made of a non-magnetic material with good tensile strength qualities such as aluminum or stainless steel.

The Examiner has indicated that the '438 patent and Mischler et al. teach every aspect of the invention except a steel band peripherally around the stator. This indication is, respectfully, traversed.

As discussed hereinabove in connection with the 103(a) rejection of claims 1, 2, 3, 8, 19-22, and 35 over the '438 patent and Mischler et al., amended claim 1 calls for a stator comprised of segments, each of which comprises a plurality of layers of amorphous metal strips, wherein each of the strips has a top and a bottom surface and is oriented such that (i) a line normal to either of the

surfaces at substantially any point thereon is substantially perpendicular to the axis of rotation of the rotor, and (ii) when traversing the segment, the flux crosses one air gap. Even taking the '438 patent and Mischler et al. teaching together, there is not produced any suggestion whatsoever concerning a stator that satisfies the combined requirements of provisos (i) and (ii).

The Examiner has indicated that it would be obvious to construct a stator of the type defined by the '438 patent and Mischler et al. with the steel band disclosed in Thomas. Like Mischler et al., Thomas does not disclose or suggest an amorphous metal stator wherein the flux crosses only one air gap. Thomas also teaches a stator composed of stacked laminations, each having a surface whose normal is parallel, not perpendicular, to the axis of rotation of the rotor with which the stator is associated. Further, Thomas does not teach an amorphous metal stator that is not brittle, and which exhibits increased magnetic permeability and overall efficiency without adverse thermal characteristics. In this respect, Thomas does not add to the teaching of the '438 patent and Mischler et al. and cannot be combined therewith to render obvious the invention recited by amended claims 4, 5, and 23. When compared to any stator constructed in view of the teaching of the '438 patent, modified in light of Mischler et al. and further modified in light of Thomas, the stator required by amended claims 4, 5, and 23 exhibits increased economy of construction and improved operating versatility and efficiency.

Accordingly, reconsideration of the rejection of amended claims 4, 5, and 23 as being unpatentable over the '438 patent, Mischler et al. and Thomas is respectfully requested.

Claims 6, 7, 24, and 25 were rejected under 35 U.S.C. § 103(a) as being unpatentable over the '438 patent, Mischler et al., Thomas, and further in view of U.S. Patent No. 3,591,819 to Laing.

The Examiner has indicated that the '438 patent, Mischler et al., and Thomas teach every aspect of the invention except the bonding material being an epoxy resin and the inner restraining

member being a bonding material and a metal band. For the reasons set forth above in conjunction with the rejection of claims 4, 5, and 23 under 35 U.S.C. § 103(a) over the '438 patent, Mischler et al., and Thomas, applicants respectfully traverse this statement. It is submitted that Thomas does not cure the lack of disclosure in the '438 patent and Mischler et al. concerning a stator comprising amorphous metal strips oriented such that (i) a line normal to either of the surfaces at substantially any point thereon is substantially perpendicular to the axis of rotation of the rotor, and (ii) when traversing the segment, the flux crosses one air gap.

The Examiner has indicated that it would be obvious to construct the stator of the '438 patent, Mischler et al. and Thomas with the synthetic resin taught by Laing. Applicants submit that even if the combination proposed by the Examiner were made, such a stator would lack the advantageous structure and properties exhibited by the stator defined by claims 6, 7, 24, and 25.

Like Mischler et al. and Thomas, Laing does not disclose or suggest amorphous metal stators wherein the flux crosses only one air gap. Like Thomas, Laing also teaches a stator composed of stacked laminations, each having a surface whose normal is parallel, not perpendicular, to the axis of rotation of the rotor with which the stator is associated. Further, Laing does not teach an amorphous metal stator which is not brittle, and which exhibits enhanced magnetic permeability and overall efficiency without adverse thermal characteristics. In this respect, Laing does not add to the teachings of the '438 patent, Mischler et al. and Thomas, and cannot be combined therewith to render obvious the invention recited by present claims 6, 7, 24, and 25. Any stator constructed from the combined teachings of the '438 patent, Mischler et al., Thomas and Laing would lack the structure and advantageous properties of the stator delineated by present claims 6, 7, 24, and 25, and as such would be far more expensive to construct and operate.

The Examiner has further indicated that Laing teaches a laminated stator having a plurality of sections, where the sections are held together by a synthetic resin and a rivet. However, applicants respectfully traverse the Examiner's equation of the Laing rivet with the metal band required by applicants' amended claims 7 and 25. A "rivet" is defined by Merriam Webster's Third International Dictionary as: "a headed pin or bolt of some malleable material (as wrought iron, mild steel, or copper) used for uniting two or more pieces by passing the shank through a hole in each piece and then beating or pressing down the plain end so as to make a second head," whereas a "band" is: "a thin flat encircling strip, strap, or flat belt of material serving chiefly to bind or contain something." It is respectfully submitted that the rivet of Laing clearly does not disclose or suggest the band required by claims 7 and 25.

As set forth above in connection with the rejection of claims 4, 5, and 23, even in combination, the '438 patent, Mischler et al., and Thomas references fail to disclose applicants' claimed structure as recited by independent claims 1 and 22, from which amended claims 6, 7, 24, and 25 depend. The Examiner has not pointed to any teaching in Laing that cures this deficiency or any suggestion in Laing that would motivate a skilled artisan to modify the combined teaching of the '438 patent, Mischler et al., and Thomas references to produce the structures required by present claims 6, 7, 24, and 25.

Accordingly, reconsideration of the rejection under 35 USC 103(a) of claims 6, 7, 24, and 25 as being unpatentable over the '438 patent, Mischler et al., Thomas and Laing is respectfully requested.

Claims 9 and 34 have been rejected under 35 USC 103(a) as being unpatentable over the '438 patent and Mischler et al. in further view of U.S. Patent No. 4,197,146 to Frischmann. The

Examiner has indicated that it would have been obvious to construct the stator of the '438 patent and Mischler et al. with the amorphous metal composition disclosed in Frischmann.

Like Mischler et al., Frischmann does not disclose or suggest an amorphous metal stator wherein the flux crosses only a minimum number of air gaps. In addition, the stator disclosed by Frishmann requires that the flux cross many air gaps, that is, the gaps between the compacted, discontinuous flakes. As a result, the Frishmann stator is inherently incapable of exhibiting enhanced magnetic permeability and overall efficiency without adverse thermal characteristics. While Frischmann discloses an amorphous metal composition for fabricating electrical magnetic components, his stator lacks the advantageous features afforded by the stator called for by applicants' present claims 9 and 34. Moreover, Frischmann does not remedy the lack of disclosure in the '438 patent and Mischler et al. concerning the particular orientation of amorphous metal strips called for by amended claims 9 and 34. In these respects, Frischmann does not add to the teaching of the '438 patent and Mischler et al., and cannot be combined therewith to render obvious the invention recited by amended claims 9 and 34.

Accordingly, reconsideration of the rejection of claims 9 and 34, as amended, under 35 U.S.C. §103(a) over the '438 patent, Mischler et al. and Frischmann is respectfully requested.

Claims 10 and 11 have been rejected as being unpatentable over '438 patent, Mischler et al., and Frischmann in further view of U.S. Patent No. 4,409,041 to Datta et al. The Examiner has indicated that '438 patent, Mischler et al., and Frischmann teach every aspect of the invention except the FeBSi formula and that it would have been obvious to construct the stator of '438 patent, Mischler et al., and Frischmann with the amorphous metal set forth in claims 10 and 11, because Datta et al. suggest the disclosed compositional range, as well as the disclosed range for enhancing the composition's magnetic properties.

The Examiner's indication that the '438 patent, Mischler et al., and Frischmann teach every aspect of the invention except the FeBSi formula is respectfully traversed, for the reasons set forth above in connection with the remarks on the rejection of claims 9 and 34 under 35 U.S.C. §103(a).

The Datta et al. disclosure is directed to an iron-based, boron containing magnetic alloy having at least 85 percent of its structure in the form of an amorphous metal matrix annealed in the absence of a magnetic field at a temperature and for a time sufficient to induce precipitation therein of discrete particles of its constituents. No disclosure or suggestion is provided by Datta et al. of the desirability of using amorphous metal in the construction of electric motor components. Moreover, the disclosure of magnetic properties found in Datta et al. is directed to high frequency properties. Each of the examples in Datta et al. discloses properties measured on a magnetic core having a closed magnetic path and carried out e.g. at a frequency of 50 kHz and at an induction level of 0.1 T. One skilled in the art would recognize that losses measured in an open magnetic circuit are higher than those seen in a closed path, as discussed in more detail by applicants in the specification at page 17, lines 20-31.

Clearly the Datta et al. disclosure is directed to core applications, not to motors or other rotating devices. Applicants thus submit that one of ordinary skill would not be motivated to combine the Datta et al. disclosure with any of the '438 patent, Mischler et al., and Frischmann. However, even assuming arguendo that the combination of the '438 patent, Mischler et al., and Frischmann with Datta et al. were to be made, the resulting stator would still lack the advantageous structure and properties afforded by applicants' stator, as recited by amended claims 10 and 11. More specifically, the stator would not have in combination a structure having a plurality of layers of amorphous metal strips, each of which has a top and a bottom surface and is oriented such that (i) a line normal to either of the surfaces of the strips at substantially any point thereon is substantially

perpendicular to the axis of rotation of the rotor, and (ii) when traversing the segment, the flux crosses one air gap. As a consequence, any stator constructed from the combined teachings of the cited references would lack the advantageous magnetic properties, including high induction and low material cost (see page 14, line 29, to page 15, line 5 of applicants' specification) afforded by the stator of present claims 10 and 11. For these reasons, applicants respectfully submit that the stator recited by claims 10 and 11, as amended, is patentable over any combination of the '438 patent, Mischler et al., Frischmann, and Datta et al.

Accordingly, reconsideration of the rejection of present claims 10 and 11 under 35 U.S.C. §103(a) is respectfully requested.

Claim 12 has been rejected under 35 U.S.C. §103(a) as being unpatentable over of the '438 patent, Mischler et al., and Frischmann, in further view of U.S. Patent No. 5,922,143 to Vernin et al. The Examiner has indicated that the '438 patent, Mischler et al., and Frischmann, teach every aspect of the invention except nanocrystalline microstructure.

The Vernin et al. patent discloses a process for manufacturing a magnetic core made of an iron-based soft magnetic alloy having a nanocrystalline structure. The alloy is formed into a toroidal magnetic core and heat-treated based on particular conditions determined on the basis of the use envisaged for the magnetic core. No suggestion or disclosure is provided in the Vernin et al patent of application of nanocrystalline alloys in motors or other rotating electrical machinery. As discussed hereinabove in connection with the rejection of claims 10 and 11 over the '438 patent, Mischler et al., and Frischmann, in further view of U.S. Patent No. 4,409,041 to Datta et al., applicants submit that one of ordinary skill would not be motivated to combine the Vernin et al. disclosure, which is directed to magnetic core applications, with any of the '438 patent, Mischler et al., and Frischmann, each of which discloses aspects of electric motor construction.

However, even if the Examiner's proposed combination of Vernin et al. with the '438 patent, Mischler et al., and Frischmann were to be combined with Vernin et al. in the manner proposed by the Examiner, the resultant device would still not suggest the stator called for by applicants' present claim 12. As discussed hereinabove, applicants' claims call for a stator comprised of segments, each of which comprises a plurality of layers of amorphous metal strips, each of which has a top and a bottom surface and is oriented such that (i) a line normal to either of the surfaces at substantially any point thereon is substantially perpendicular to the axis of rotation of the rotor, and (ii) when traversing the segment, the flux crosses one air gap. None of the cited references or any combination thereof suggests this combination of structural features. In contrast, the presence of these features in applicants' stator as recited by amended claim 12 results in low core loss and thus a motor that is smaller, lighter, less expensive to construct and more versatile and efficient in operation than a motor employing a prior art stator.

As previously discussed, the low value of core loss afforded by the present stator results in a motor that is more efficient, generates less waste heat that must be dissipated, and is capable of higher speed operation than a motor employing any conventional steel core material. As discussed in detail by the specification, e.g. at page 16, lines 18-19 and 27-29, stators employing nanocrystalline alloy strip are especially preferred for motors wherein minimum size and high speed operation are desired.

It is therefore submitted that the proposed combination of Vernin et al. with the '438 patent, Mischler et al., and Frischmann, even if proper, does not disclose or suggest the stator recited by present claim 12.

Accordingly, reconsideration of the rejection of claim 12 under 35 U.S.C. §103(a) as being unpatentable over the combination of the '438 patent, Mischler et al., Frischmann, and Vernin et al., is respectfully requested.

Claims 13 and 14 have been rejected under 35 U.S.C. §103(a) as being unpatentable over the '438 patent, Mischler et al., Frischmann, and Vernin et al., in further view of U.S. Patent 4,881,989 to Yoshizawa et al. The Examiner has indicated that the '438 patent, Mischler et al., Frischmann, and Vernin et al. teach every aspect of the invention except the compositions set forth in claims 13 and 14 and that it would be obvious to construct the stator of the '438 patent, Mischler et al., Frischmann, and Vernin et al. with the compositions of claims 13 and 14.

Yoshizawa et al. discloses an iron-base soft magnetic alloy having a composition represented by the general formula:  $(\text{Fe}_{1-a}\text{M}_a)_{100-x-y-z-\alpha-\beta-\gamma}\text{Cu}_x\text{Si}_y\text{B}_z\text{M}'_\alpha\text{M}''_\beta\text{X}_\gamma$  wherein M is Co and/or Ni, M' is at least one element selected from the group consisting of Nb, W, Ta, Zr, Hf, Ti and Mo, M'' is at least one element selected from the group consisting of V, Cr, Mn, Al, elements in the platinum group, Sc, Y, rare earth elements, Au, Zn, Sn and Re, X is at least one element selected from the group consisting of C, Ge, P, Ga, Sb, In, Be and As, and a, x, y, z,  $\alpha$ ,  $\beta$ , and  $\gamma$ , respectively, satisfy  $0 \leq a \leq 0.5$ ,  $0.1 \leq x \leq 3$ ,  $0 \leq y \leq 30$ ,  $0 \leq z \leq 25$ ,  $5 \leq y+z \leq 30$ ,  $0.1 \leq \alpha \leq 30$ ,  $\beta \leq 10$  and  $\gamma \leq 10$ , at least 50% of the alloy structure being fine crystalline particles having an average particle size of 100 nm or less. This alloy is said to have low core loss, time variation of core loss, high permeability and low magnetostriction. Yoshizawa et al. also discloses toroidal magnetic cores for use in various transformers, choke coils, saturable reactors, magnetic heads, and the like.

Applicants respectfully traverse the position of the Examiner that the '438 patent, Mischler et al., Frischmann, and Vernin et al. teach every aspect of the invention except the compositions set forth in claims 13 and 14. As set forth above in connection with the discussion concerning the

rejection of claim 12 under 35 U.S.C. §103(a), applicants submit that the combination of the '438 patent, Mischler et al., Frischmann, and Vernin et al. does not suggest a stator having a plurality of segments, each segment comprising a plurality of layers of amorphous metal strips; each of which layers has a top and a bottom surface and is oriented such that (i) a line normal to either of the surfaces at substantially any point thereon is substantially perpendicular to the axis of rotation of the rotor, and (ii) when traversing the segment, the flux crosses one air gap, required by present claims 13 and 14.

Moreover, the Yoshizawa et al. disclosure does not have any teaching concerning the utility of any composition therein for the construction of electric motors or other rotating electrical machines. For the reasons set forth hereinabove in connection with the rejection of claim 12, applicants submit that a skilled artisan would not be motivated to combine the Yoshizawa et al. disclosure directed to electronic core applications with the Mischler et al, Frischmann, and '438 patent disclosures, as proposed by the Examiner.

However, even assuming that the combination of Yoshizawa et al. with the '438 patent, Mischler et al., Frischmann, and Vernin et al. could properly be made, it would not render obvious the stator called for by applicants' amended claims 13 and 14, because any stator produced in light of the combined teachings of the cited references would still lack the advantageous structure and properties afforded by applicants' stator, as recited by claims 13 and 14. More specifically, any stator constructed from the combined teachings of the cited references would not contain in combination a structure having a plurality of layers of amorphous metal strips, each of which has a top and a bottom surface and is oriented such that (i) a line normal to either of the top and bottom surfaces at substantially any point thereon is substantially perpendicular to the axis of rotation of the rotor, and (ii) when traversing the segment, the flux crosses one air gap. Moreover, such a stator

produced from the combined teachings of the cited references would clearly lack the advantageous magnetic properties afforded by the stator of applicants' amended claims 13 and 14. As set forth at page 16, lines 18-19 and 27-29 of applicants' specification, stators employing nanocrystalline alloy strip are especially preferred for motors wherein minimum size and high-speed operation are desired.

Accordingly, reconsideration of the rejection of claims 13 and 14 under 35 U.S.C. §103(a) over the combination of the '438 patent, Mischler et al., Frischmann, and Vernin et al., with Yoshizawa et al. is respectfully requested.

Claims 15-18, 26-33, and 36 have been rejected under 35 U.S.C. §103(a) as being unpatentable over the '438 patent and Mischler et al. The Examiner has indicated that the '438 patent and Mischler et al. teach every aspect of the invention except the core loss and frequency range of the magnetic material, and it would be obvious to the skilled artisan to construct the stator core of the '438 patent and Mischler et al. to optimize the magnetic characteristics of the amorphous material.

Applicants respectfully traverse this statement. As discussed hereinabove in connection with the rejection of claims 1, 2, 3, 8, 19-22, and 35 over the combination of the '438 patent and Mischler et al., each of claims 15-18, 26-33, and 36 recites a stator having a plurality of segments. Each segment comprises a plurality of layers of amorphous metal strips, and each of layer of strip has a top and a bottom surface and is oriented such that (i) a line normal to either of the surfaces at substantially any point thereon is substantially perpendicular to the axis of rotation of the rotor, and (ii) when traversing the segment, the flux crosses one air gap. Clearly, this combination of structural elements is not disclosed or suggested by the combination of the '438 patent and Mischler

et al. In fact, as previously noted, the proposed combination of '438 patent and Mischler et al. teaches away from the stator structure that contains the elements of provisos (i) and (ii).

Moreover, applicants respectfully disagree that claims 15-18, 26-33, and 36 amount merely to optimization of magnetic characteristics of a core. Clearly, the advantageously low core loss afforded by applicants' amorphous magnetic component is a result; not a design choice that the skilled worker can readily "dial up" on command. It is therefore submitted that amended claims 15-18, 26-33, and 36 are patentable over the combination of the '438 patent and Mischler et al.

Accordingly, reconsideration of the rejection of claims 15-18, 26-33, and 36 under 35 U.S.C. §103(a) as being unpatentable over the '438 patent and Mischler et al. is respectfully requested.

Claims 19-21 and 28-30 have been rejected under 35 U.S.C. §103(a) as being unpatentable over the '438 patent and Mischler et al. in further view of U.S. Patent No. 4,763,030 to Clark et al.

The Clark et al. patent discloses a metallic glass ribbon having the formula  $Fe_wB_xSi_yC_z$  wherein  $0.78 \leq w \leq 0.83$ ,  $0.13 \leq x \leq 0.17$ ,  $0.03 \leq y \leq 0.07$ ,  $0.005 \leq z \leq 0.03$ , and  $w+x+y+z=1$ . The ribbon is annealed to remove mechanical strains and exposed to a magnetic field in the plane of the ribbon and transverse to the long axis of the ribbon. The resulting metallic glass ribbons have very large magnetic coupling coefficients ( $k_{33} > 0.9$ ). The treated ribbons are said to be useful in magnetostrictive transducers and in passive listening devices such as hydrophones or pressure sensors. No disclosure is provided by the Clark et al patent of the use of metallic glass or amorphous metal ribbon in the construction of components of electric motors. Moreover there is no suggestion in Clark et al. that amorphous metal ribbons having high magnetomechanical coupling factor are advantageous for use in construction of an electric motor.

The Examiner has stated that the '438 patent and Mischler et al. teach every aspect of the invention, except the heat treatment, application of a magnetic field, and annealing the segments. This statement is respectfully traversed. As discussed hereinabove in connection with the 103(a) rejection of claims 1, 2, 3, 8, 19-22, and 35 over the '438 patent and Mischler, present claim 1 calls for a stator comprised of segments. Each of the segments comprises a plurality of layers of amorphous metal strips, and each of the strips has a top and a bottom surface and is oriented such that (i) a line normal to either of the surfaces at substantially any point thereon is substantially perpendicular to the axis of rotation of the rotor, and (ii) when traversing the segment, the flux crosses one air gap. Even taking together the '438 patent and Mischler et al. teachings, there is no suggestion therein concerning a stator that satisfies the combined features of provisos (i) and (ii). Clark et al. do not disclose or suggest use of amorphous metal in electric motor components of any kind, let alone construction of the amorphous metal stator set forth in present claims 1, 2, 3, 8, 19-22, and 35. Clearly, a stator constructed in accordance with the combined teaching of the '438 patent and Mischler et al. even if annealed in the manner taught by Clark et al., would still lack the advantageous combination of structure and properties afforded by applicants' stator, as recited by claims 19-21 and 28-30. The stator would not comprise amorphous metal strips oriented such that, when traversing a segment, the flux crosses one air gap, as required by present claims 19-21 and 28-30 wherein the flux crosses only one air gap. It would not comprise amorphous metal strips oriented such that a line normal to either of the surfaces at substantially any point thereon is substantially perpendicular to the axis of rotation of the rotor. Thus, the Clark et al. teaching does not add to the teachings of the '438 patent and Mischler et al. and cannot be combined therewith to render obvious the invention recited by present claims 19-21 and 28-30.

The Examiner further indicates that claims 28-30 are method of making limitations which are not germane to the patentability of the apparatus. As discussed hereinabove in conjunction with the rejection of claims 1, 2, 3, 8, 19-22, and 35 under 35 U.S.C. § 103(a), applicants respectfully submit that heat treatment or annealing, whether or not a magnetic field is applied, is a structural feature of the stator recited in claims 28-30 also and is thus properly germane to the determination of patentability of those claims. The Examiner has suggested that Clark, along with Yoshizawa and Vernin merely support Mischler to teach various elements of the amorphous material in magnetic cores. Applicants acknowledge that each of Clark, Yoshizawa, and Vernin provide teachings concerning amorphous metals. However, applicants respectfully submit that the Examiner has not pointed to those elements in either of Clark, Yoshizawa, or Vernin that fairly disclose or suggest the particular features and properties set forth in applicants' amended claims 19-21 and 28-30.

Accordingly, reconsideration of the rejection of claims 19-21 and 28-30 under 35 U.S.C. §103(a) over the '438 patent, Mischler et al. and Clark et al. is respectfully requested.


Claims 26 and 36 were rejected under the judicially created doctrine of obviousness-type double patenting over claim 1 of U. S. Patent 6,462,456.

In order to expedite prosecution of this application, enclosed herewith is a Terminal Disclaimer in the form required by 37 CFR 1.321 (b). The Terminal Disclaimer includes a statement by the assignee specifying that the evidentiary documents have been reviewed and certifying that, to the best of the assignee's knowledge and belief, title is in the assignee seeking to take action. As such, the Terminal Disclaimer is submitted to be in compliance with 37 CFR 3.73 (b), and is in the proper form required by 37 CFR 1.321. In view of the same, it is submitted that claims 26 and 36 should not be subject to rejection based on obviousness-type double patenting with U. S. Patent 6,462,456.

Accordingly, reconsideration of the rejection of present claims 26 and 36 under the judicially created doctrine of obviousness-type double patenting as being unpatentable over claim 1 of U. S. Patent 6,462,456 is respectfully requested.

In view of the amendments to claims 1, 22, 26, 35, and 36, the Terminal Disclaimer submitted herewith, and the remarks set forth above, it is submitted that the present application is in allowable condition. Reconsideration of the rejection of claims 1-36, and allowance of the application are, therefore, earnestly solicited.

Respectfully submitted,  
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